PERSISTENCE IN HIGHER S/E EDUCATION

S/E Baccalaureate to S/E Doctorate Productivity of U.S. Baccalaureate-Granting Institutions

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I. INTRODUCTION

Purpose of Report

In an earlier report, "Institutional Productivity: The Undergraduate Origins of Science and Engineering PhDs", this author calculated productivity ratios [1] for U.S. baccalaureate-granting colleges and universities, and identified the leading undergraduate sources of science/engineering PhDs. The analysis was based on BA and PhD data for six benchmark years [1950-51, 1955-56, 1960-61, 1965-66, 1970-71, and 1975-76]. and limited to the top 100 institutions and specially selected technical institutions, liberal arts colleges, predominately women's colleges, and traditionally black colleges.

The purpose of the current study is to further analyze the BA to PhD pipeline data for the 170 institutions that have either been identified as highly productive institutions or as institutions of special interest to policymakers and educational planners.

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1. Institutional productivity ratios measure the contribution of baccalaureate-granting institutions to PhD production, while controlling for size of the institution. The ratio is calculated by dividing the number of baccalaureates from institution "A" that earned a science/engineering PhD from either institution "A" or another doctoral-granting institution for a specific referenced BA year(s) by the total number of baccalaureates awarded by institution "A" for the same referenced year(s).

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II. METHODOLOGY

Data Sources

From 1969 annual baccalaureate production counts by field of baccalaureate were available on tape. However, prior to this time the only source of this data was the published reports [2] from the U.S. Department of Education.

In consideration of the magnitude of the task involved in manually extracting baccalaureate counts by field of study for approximately 170 undergraduate institutions prior to the availability of taped data, only 7 institutions were selected for the 10-year trend analysis [Emory University (GA), University of Illinois (IL), Massachusettes Institute of Technology (MA), Cornell University (NY), Reed College (OR), Bryn Mawr College (PA), and Texas A&M University (TX)].

From 1969-70 to 1974-75, all 170 baccalauretate-granting institutions that had been analyzed in the previous study on institutional productivity were again analyzed to determine their science/engineering baccalaureate to science/engineering PhD productivity ratios, a much more detailed picture of the BA to PhD pipeline for science and engineering.

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2. National Center for Education Statistics, Department of Health, Education, and Welfare, Earned Degrees Conferred (Washington, DC: U. S. Government Printing Office).

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In addition to the NCES data on baccalaureate counts, the National Research Council's Doctorate Records file (DRF) was used in this report as the source for PhD data.

Evaluation Criteria

The S/E productivity ratios were calculated by dividing the number of individuals who earned baccalaureates from institution "A" and continued on to earn a science/engineering doctorate by the number of individuals who earned baccalaureates in science/engineering from institution "A" for the same referenced year(s).

Tables 1 though 5 provide these year by year S/E productivity ratios, as well as the average productivity ratio for each institution over the six year period from 1969-70 to 1974-75. The average productivity ratios were based only on those years for which it was possible to calculate ratios. For example, all six S/E productivity ratios were calculated for California Institute of Technology, and as such, the average productivity ratio for this institution represented the average for all six referenced years. However, for Antioch College the 1971-72 S/E baccalaureate data were not available from the NCES data tapes; therefore, the average productivity ratio for Antioch was based on only 5 referenced years.

Blanks in the following tables indicate that data on S/E

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baccalaureate counts were not available from the NCES data tapes, whereas, a zero indicates that none of the BA graduates continued on to earn a doctorate in S/E for that particular institution during the specified year.

Definition of S/E Baccalaureate Fields

The science/engineering codes used by NCES for defining baccalaureate fields in their Degree & Other Formal Award Conferred Questionnaire (the survey on which the BA counts in this report were based) changed over the years. A code conversion, however, was developed to assure that the same definition of science/engineering BAs was used throughout this report.

Science/engineering fields were defined as agriculture and natural resources, biological sciences, computer and information sciences, engineering, health professions, mathematics, physical sciences, psychology, and social sciences.

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III. S/E PRODUCTIVITY RATIOS FOR BACCALAUREATE INSTITUTIONS FROM 1969-70 TO 1974-75

Top 100 Institutions

Table 1 provides information on the science/engineering productivity ratios for the leading 100 undergraduate sources of S/E PhDs for the years 1969-70 through 1974-75. The order in which the institutions are listed corresponds to the rank ordering (high to low productivity) of these institutions when only the S/E PhD to total BA ratios were computed for the 1950, 1955, 1960, 1965, 1970, and 1971 benchmark years.

As the reader will note, the highly productive institutions such as California Institute of Technology (CA), Harvey Mudd College (CA), Reed College (OR), and Massachusetts Institute of Technology (MA) continue to be the most productive institutions, even when ratios are calculated controlling for field of baccalaureate.

As one would suspect, a number of institutions show an increase in their BA to PhD productivity when the baccalaureates in science/engineering were used in the calculation of productivity ratios rather than the total of all baccalaureates graduating from the institution. Institutions for which the 1969 to 1974 S/E productivity ratios were considerably higher than they were when based on all

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baccalaureate graduates for the six benchmark years between 1950 and 1975 include New College of South Florida (FL), University of Chicago (IL), Eckerd College (FL), Pomona College (CA), Columbia University (NY), Oberlin College (OH), Wellesley College (MA), and Bard College (NY).

The S/E productivity ratios declined for Webb Institute of Naval Architecture (NY) from which only two of its 1969 to 1974 baccalaureates continued on to earn a S/E PhD, and for the U.S. Merchant Marine Academy from which only seven of its 1969 to 1974 baccalaureats obtained PhDs in S/E.

The reader should again note that the average S/E productivity ratios are based only on those years for which it was possible to calculate productivity ratios. The 1.9% average S/E productivity ratio for Webb Institute of Naval Architecture represents its productivity average over the six year period, even though the two baccalaureates who earned S/E PhDs both earned their baccalaureates in the same year, 1972-73.

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TABLE 1

S/E BACCALAUREATE TO S/E PHD PRODUCTIVITY RATIOS FOR THE LEADING 100 UNDERGRADUATE SOURCES OF S/E PHDS, 1969 TO 1974.

INSTITUTION	TOTAL # S/E PHDS	AVERAGE PRODUCTIVITY RATIO	S/E PRODUCTIVITY RATIOS 1969 %	1970 %	1971 %	1972 %	1973 %	1974 %
CAL INST TECHNOLOGY	407	42.6	42.9	37.4	47.9	43.9	40.2	44.6
HARVEY MUDD COLL/CA	130	33.8	47.5	30.4	34.2	33.3	29.0	29.0
REED COLLEGE/OR	182	25.7	26.7	24.6	24.3	30.9	26.6	21.6
MASS INST TECHNOLOGY	1181	24.0	24.4	24.8	26.5	26.7	22.3	19.5
NEW COLL-SOUTH FLA U	76	23.2	10.3	22.7	25.0	28.8	22.4	25.0
CHICAGO, UNIV OF/IL	399	21.0	21.2	24.4	20.4	19.0	20.7	19.4
HAVERFORD COLL/PA	93	17.3	19.0	18.9	15.7	15.5	15.7	19.4
SWARTHMORE COLL/PA	180	16.5	20.9	23.2	16.8	15.2	11.1	14.7
POMONA COLLEGE/CA	183	16.3	18.0	16 8	19.8	15.3	13.2	14.8
OBERLIN COLLEGE/OH	283	15.6	21.6	16.1	14.5	17.2	16.4	8.6
CARLETON COLLEGE/MN	194	15.6	15.0	13.8	17.1	17.3	14.1	16.3
COOPER UNION/NY	95	15.5	10.0	14.3	19.8	14.0	14.6	23.0
RICE UNIVERSITY/TX	331	14.3	23.5	21.2	13.4	11.9	10.6	9.7
BRYN MAWR COLL/PA	90	13.9	17.3	21.4	11.0	14.0	13.6	8.3
AMHERST COLLEGE/MA	124	13.3	14.9	16.5	10.5	18.1	11.5	9.4
CALIF, U-SAN DIEGO	460	13.2	19.2	16.7	13.9	13.4	12.0	9.9
PRINCETON UNIV/NJ	436	12.7	8.7	16.0	12.2	13.3	11.8	13.9
CORNELL UNIV/NY	1120	12.6	10.7	11.1	10.9	11.3	17.5	17.6
ECKERD COLLEGE/FL	57	12.3	10.8	7.8	14.0	11.9	11.7	18.6
YALE UNIVERSITY/CT	479	12.2	11.7	12.7	10.4	13.1	12.4	13.0

NOTE: TOTAL NUMBERS OF S/E PHDS ARE BASED ON DATA FROM 1969-70, 1970-71, 1971-72, 1972-73, 1973-74 AND 1974-75.

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TABLE 1

S/E BACCALAUREATE TO S/E PHD PRODUCTIVITY RATIOS FOR THE LEADING 100 UNDERGRADUATE SOURCES OF S/E PHDS, 1969 TO 1974.

INSTITUTION	TOTAL # S/E PHDS	AVERAGE PRODUCTIVITY RATIO	S/E PRODUCTIVITY RATIOS 1969 %	1970 %	1971 %	1972 %	1973 %	1974 %
JOHNS HOPKINS U/MD	310	11.9	12.6	15.0	11.0	10.3	11.6	11.7
BROWN UNIVERSITY/RI	479	11.7	13.5	13.2	11.4	13.2	10.4	9.4
COLUMBIA UNIV/NY	594	11.3	11.8	12.4	15.3	10.4	10.5	7.5
WESLEYAN UNIV/CT	136	11.2	12.5	13.6	9.1	12.8	9.5	10.1
BRANDEIS UNIV/MA	245	11.1	13.5	13.7	9.3	12.7	8.8	8.5
HARVARD UNIV/MA	660	11.0	11.3	12.1	10.2	9.7	11.9	11.0
WELLESLEY COLLEGE/MA	149	10.8	11.0	10.2	14.4	10.0	7.6	12.2
GRINNELL COLLEGE/IA	106	10.8	20.0	11.5	8.9	10.3	8.0	9.7
BARD COLLEGE/NY	24	10.7	12.5	7.7	12.9	14.7	11.4	6.0
ANTIOCH COLLEGE/OH	127	10.3	14.3	17.1		9.0	7.4	7.7
CARNEGIE-MELLON U/PA	253	10.3	12.5	10.0	11.0	9.5	9.8	9.3
WILLIAMS COLLEGE/MA	129	10.1	9.9	10.2	8.9	11.5	11.1	9.3
DAVIDSON COLLEGE/NC	88	10.1	8.3	13.0	12.5	10.6	9.5	7.5
RENSSELAER POLY I/NY	401	10.0	9.4	9.5	9.7	11.6	10.3	9.3
CALIF,U-SANTA CRUZ	316	10.0	9.9	8.8	8.6	11.5	10.0	11.0
KALAMAZOO COLLEGE/MI	98	9.8	7.1	8.3	10.3	14.6	8.6	9.7
ROCHESTER,UNIV OF/NY	446	9.6	9.9	9.7	10.1	11.0	8.4	8.6
CASE WESTRN RSRVE/OH	400	9.4	11.4	11.4	9.0	10.6	7.5	6.2
LAWRENCE UNIV/WI	86	9.4	14.3	14.9	4.2	9.9	8.7	4.1
VASSAR COLLEGE/NY	133	9.1	13.5	8.6	12.5	3.7	7.5	9.5

NOTE: TOTAL NUMBERS OF S/E PHDS ARE BASED ON DATA FROM 1969-70, 1970-71, 1971-72, 1972-73, 1973-74 AND 1974-75.

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TABLE 1

S/E BACCALAUREATE TO S/E PHD PRODUCTIVITY RATIOS FOR THE LEADING 100 UNDERGRADUATE SOURCES OF S/E PHDS, 1969 TO 1974.

INSTITUTION	TOTAL # S/E PHDS	AVERAGE PRODUCTIVITY RATIO	S/E PRODUCTIVITY RATIOS 1969 %	1970 %	1971 %	1972 %	1973 %	1974 %
STANFORD UNIV/CA	643	8.9	9.3	9.6	7.7	10.0	3.8	8.2
SUNY AT STONY BROOK	626	8.9	9.8	12.0	10.0	8.2	6.8	7.7
N MEX I MINING&TECH	51	8.8	8.5	9.3	5.7	13.3	7.3	9.4
CALIF,U-IRVINE	335	8.4	10.4	9.0	9.1	6.7	9.4	7.3
CLARK UNIVERSITY/MA	159	8.3	7.8	6.5	9.1	10.0	9.9	6.4
BUCKNELL UNIV/PA	200	8.3	7.1	9.5	8.6	8.4	8.2	8.1
HAMILTON COLLEGE/NY	79	7.9	12.0	8.7	7.7	7.0	8.3	5.0
WOOSTER, COLL OF/OH	104	7.8	12.4	7.7	4.6	7.9	8.1	6.5
OCCIDENTAL COLL/CA	121	7.7	9.3	10.5	6.4	7.8	8.2	4.6
BELOIT COLLEGE/WI	88	7.5	6.5	10.5	6.2	10.5	7.2	5.0
EARLHAM COLLEGE/IN	68	7.3		12.7	6.8	4.2	7.6	6.4
MACALESTER COLL/MN	103	7.3	12.8	8.1	7.4	4.3	7.5	5.6
DUKE UNIVERSITY/NC	409	7.3	9.6	9.1	8.1	7.1	4.9	6.4
FRNKLN&MARSHAL C/PA	119	7.2	9.6	7.3	6.6	6.8	7.1	6.4
STEVENS INST TECH/NJ	104	7.1	8.7	5.2	5.5	6.1	9.6	9.5
CALIF,U-RIVERSIDE	329	7.0	9.7	6.2	6.6	6.9	6.9	6.3
KNOX COLLEGE/IL	84	7.0	6.9	6.2	6.3	10.2	8.2	3.3
CALIF, U-BERKELEY	1490	7.0	8.6	6.9	7.5	6.8	6.5	5.6
BOWDOIN COLLEGE/ME	74	6.9	9.7	8.1	9.4	7.7	2.6	4.7
WABASH COLLEGE/IN	51	6.8	6.9	7.1	4.5	9.8	6.1	5.8

NOTE: TOTAL NUMBERS OF S/E PHDS ARE BASED ON DATA FROM 1969-70, 1970-71, 1971-72, 1972-73, 1973-74 AND 1974-75.

TABLE 1

S/E BACCALAUREATE TO S/E PHD PRODUCTIVITY RATIOS FOR THE LEADING 100 UNDERGRADUATE SOURCES OF S/E PHDS, 1969 TO 1974.

INSTITUTION	TOTAL # S/E PHDS	AVERAGE PRODUCTIVITY RATIO	S/E PRODUCTIVITY RATIOS 1969 %	1970 %	1971 %	1972 %	1973 %	1974 %
SUNY AT BINGHAMTON	241	6.8	7.7	5.9	9.1	7.0	6.0	5.7
DARTMOUTH COLLEGE/NH	237	6.8	8.5	5.5	7.9	8.4	5.9	4.4
BATES COLLEGE/ME	74	6.6	7.3	7.3	6.5	5.2	6.0	7.8
WHITMAN COLLEGE/WA	56	6.5	5.0	10.8	6.6	7.2	6.0	4.1
LEBANON VALLEY C/PA	48	6.4	8.6	7.1	4.0	6.9	6.7	5.6
LEHIGH UNIVERSITY/PA	196	6.3	5.5	6.4	7.3	6.9	7.5	4.4
CALIF, U-DAVIS	627	6.1	8.2	6.3	5.8	6.1	5.6	5.3
ILLINOIS INST TECH	154	6.1	7.2	6.4	3.8	7.2	7.3	5.1
HOPE COLLEGE/MI	70	5.9	4.1	6.9	5.9	7.6	6.0	4.6
POLYTECHNIC UNIV/NY	132	5.9	7.9	3.7	7.0	5.9	3.9	6.6
KENYON COLLEGE/OH	47	5.8	6.7	5.6	5.5	3.0	8.1	5.2
UNION UNIVERSITY/NY	137	5.7	5.1	5.4	6.4	5.6	4.8	6.7
DREW UNIVERSITY/NJ	61	5.6	4.9	8.1	5.5	6.4	4.4	4.7
PITZER COLLEGE/CA	30	5.6	8.1	3.8	7.2	5.7	3.9	4.4
YESHIVA UNIV/NY	78	5.6	4.0	8.4	4.0	8.8	5.9	2.9
MUHLENBERG COLL/PA	76	5.3	4.6	7.2	4.0	4.2	4.8	7.2
CENTRE COLL KENTUCKY	32	5.2	6.0	3.4	8.0	1.0	5.1	8.2
JUNIATA COLLEGE/PA	53	5.1	5.2	4.5	7.3	1.5	5.7	7.6
COLORADO SCH MINES	70	4.9	4.9	9.2	5.2	3.2	4.7	2.7
CUNY-CITY COLLEGE	506	4.8	6.5	5.2	5.2	4.3	3.5	3.2

NOTE: TOTAL NUMBERS OF S/E PHDS ARE BASED ON DATA FROM 1969-70, 1970-71, 1971-72, 1972-73, 1973-74 AND 1974-75.

TABLE 1

S/E BACCALAUREATE TO S/E PHD PRODUCTIVITY RATIOS FOR THE LEADING 100 UNDERGRADUATE SOURCES OF S/E PHDS, 1969 TO 1974.

INSTITUTION	TOTAL # S/E PHDS	AVERAGE PRODUCTIVITY RATIO	S/E PRODUCTIVITY RATIOS 1969 %	1970 %	1971 %	1972 %	1973 %	1974 %
SUNY ENVR SCI FRSTRY	71	4.7	6.5	5.7	5.1	3.9	1.6	6.4
RHODES COLLEGE/TN	39	4.6	6.2	3.4	4.5	5.3	5.7	2.2
CALIF,U-LOS ANGELES	888	4.6	5.6	5.5	4.1	4.1	3.9	4.2
IOWA STATE UNIV	441	4.5	5.5	4.8	4.1	3.6	4.6	4.2
LAFAYETTE COLLEGE/PA	105	4.5	4.4	7.0	5.3	4.5	1.8	4.0
WORCESTER POLY I/MA	93	4.5	5.6	3.1	7.5	4.5	2.6	4.8
ILL BENEDICTINE COLL	33	4.4	5.6	2.0	4.5	7.7	2.1	5.2
CHARLESTON, C OF/SC	23	4.0	4.8	6.5	5.6	1.0	3.3	4.9
BEREA COLLEGE/KY	29	3.5	3.2	4.1	2.5	3.4	5.9	1.8
PHILA C PHARM&SCI/PA	29	3.2	5.3	2.8	3.1	4.2	2.0	1.9
DELAWARE VALLEY C/PA	29	3.1	4.1	1.6	2.0	1.7	3.3	5.6
S DAKOTA S MINE&TECH	39	2.8	3.3	3.0	1.6	3.5	2.6	2.6
KING COLLEGE/TN	7	2.6	.0	2.0	.0	3.1	12.1	2.8
BLACKBURN COLLEGE/IL	10	2.2	3.7	.0	1.0	5.3	.0	2.9
WEBB I NAVAL ARCH/NY	2	1.9	.0	.0	.0	9.5	.0	.0
US MERCHANT MAR ACAD	7	.6	3.5	.5	.0	.5	.0	1.0
HAMPSHIRE COLL/MA	39		NO DATA ON S/E BAs AVAILABLE					
US MILITARY ACADEMY	62		NO DATA ON S/E BAs AVAILABLE					
ST JOHNS COLLEGE/MD	16		NO DATA ON S/E BAs AVAILABLE					
RADCLIFFE C/MA			MERGED WITH HARVARD UNIVERSITY					

NOTE: TOTAL NUMBERS OF S/E PHDS ARE BASED ON DATA FROM 1969-70, 1970-71, 1971-72, 1972-73, 1973-74 AND 1974-75.

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Technical Institutions

When S/E productivity ratios were calculated for selected technical institutions, little change was noted from those institutional productivity ratios that were calculated on the basis of the total number of baccalaureate graduates from the specified instituions. This finding is not surprising in light of the fact that the majority of graduates from technical schools tend to focus their undergraduate studies in the sciences or engineering. Thus, the institutional productivity ratios, based on the total number of BA graduates, and the S/E productivity ratios, based on only S/E BA graduates, were nearly identical.

With the exception of Webb Institute of Naval Architecture (NY), there was little change from one referenced year to the next for the technical institutions presented in table 2. Furthermore, there appeared to be no apparent trend by year of BA for institutions and their BA to PhD productivity ratios. For example, 1971-72 was a banner year for California Institute of Technology and Massachusetts Institute of Technology, but a low productivity year for Illinois Institute of Technology and South Dakota School of Mines and Technology.

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TABLE 2

S/E BACCALAUREATE TO S/E PHD PRODUCTIVITY RATIOS FOR SELECTED TECHNICAL INSTITUTIONS, 1969-1974.

INSTITUTION	TOTAL # S/E PHDS	AVERAGE PRODUCTIVITY RATIO	S/E PRODUCTIVITY RATIOS 1969 %	1970 %	1971 %	1972 %	1973 %	1974 %
CAL INST TECHNOLOGY	407	42.6	42.9	37.4	47.9	43.9	40.2	44.6
MASS INST TECHNOLOGY	1181	24.0	24.4	24.8	26.5	26.7	22.3	19.5
CARNEGIE-MELLON U/PA	253	10.3	12.5	10.0	11.0	9.5	9.8	9.3
RENSSELAER POLY I/NY	401	10.0	9.4	9.5	9.7	11.6	10.3	9.3
CASE WESTRN RSRVE/OH	400	9.4	11.4	11.4	9.0	10.6	7.5	6.2
N MEX I MINING&TECH	51	8.8	8.5	9.3	5.7	13.3	7.3	9.4
STEVENS INST TECH/NJ	104	7.1	8.7	5.2	5.5	6.1	9.6	9.5
LEHIGH UNIVERSITY/PA	196	6.3	5.5	6.4	7.3	6.9	7.5	4.4
ILLINOIS INST TECH	154	6.1	7.2	6.4	3.8	7.2	7.3	5.1
POLYTECHNIC UNIV/NY	132	5.9	7.9	3.7	7.0	5.9	3.9	6.6
COLORADO SCH MINES	70	4.9	4.9	9.2	5.2	3.2	4.7	2.7
WORCESTER POLY I/MA	93	4.5	5.6	3.1	7.5	4.5	2.6	4.8
ROSE-HULMAN TECH/IN	43	3.4	3.6	5.1	5.5	2.4	3.3	1.7
S DAKOTA S MINE&TECH	39	2.8	3.3	3.0	1.6	3.5	2.6	2.6
WEBB I NAVAL ARCH/NY	2	1.9	.0	.0	.0	9.5	.0	.0

NOTE: TOTAL NUMBERS OF S/E PHDS ARE BASED ON DATA FROM 1969-70, 1970-71, 1971-72, 1972-73, 1973-74 AND 1974-75.

Liberal Arts Colleges

The majority of the overall S/E baccalaureate to S/E PhD productivity ratios for selected liberal arts college during 1969-70 to 1974-75 increased from those institutional productivity ratios that were calculated using the total number of bacculaureate graduates.

Although Harvey Mudd College (CA) and Reed College (OR) continued to have the highest average S/E productivity ratios for the period covered by the analysis, a number of the liberal arts colleges showed a definite increase in productivity from the analysis reported for the 1950 to 1975 period when no control was made for field of baccalaureate. These institutions were Haverford College (PA), Pomona College (CA), Oberlin College (OH), Bryn Mawr College (PA), Wellesley College (MA), Vassar College (NY), and Smith College (MA).

The 1969-70 and 1970-71 years were the most productive years for the S/E BA to PhD pipeline with over half of the liberal arts colleges presented in table 3 having their highest BA to PhD yield during these two years. The reader is cautioned, however, when interpreting the lower productivity ratios for 1973-74 and 1974-75. It is likely that for these years many of the baccalaureate graduates were still in graduate school and had not yet received their PhD degrees [3].

3. See Section IV for a fuller discussion of the time it requires to complete S/E PhD degrees.

TABLE 3

S/E BACCALAUREATE TO S/E PHD PRODUCTIVITY RATIOS FOR SELECTED LIBERAL ARTS COLLEGES, 1969-1974.

INSTITUTION	TOTAL # S/E PHDS	AVERAGE PRODUCTIVITY RATIO	S/E PRODUCTIVITY RATIOS 1969 %	1970 %	1971 %	1972 %	1973 %	1974 %
HARVEY MUDD COLL/CA	130	33.8	47.5	30.4	34.2	33.3	29.0	29.0
REED COLLEGE/OR	182	25.7	26.7	24.6	24.3	30.9	26.6	21.6
HAVERFORD COLL/PA	93	17.3	19.0	18.9	15.7	15.5	15.7	19.4
SWARTHMORE COLL/PA	180	16.5	20.9	23.2	16.8	15.2	11.1	14.7
POMONA COLLEGE/CA	183	16.3	18.0	16.8	19.8	15.3	13.2	14.8
CARLETON COLLEGE/MN	194	15.6	15.0	13.8	17.1	17.3	14.1	16.3
OBERLIN COLLEGE/OH	283	15.6	21.6	16.1	14.5	17.2	16.4	8.6
BRYN MAWR COLL/PA	90	13.9	17.3	21.4	11.0	14.0	13.6	8.3
AMHERST COLLEGE/MA	124	13.3	14.9	16.5	10.5	18.1	11.5	9.4
WESLEYAN UNIV/CT	136	11.2	12.5	13.6	9.1	12.8	9.5	10.1
GRINNELL COLLEGE/IA	106	10.8	20.0	11.5	8.9	10.3	8.0	9.7
WELLESLEY COLLEGE/MA	149	10.8	11.0	10.2	14.4	10.0	7.6	12.2
ANTIOCH COLLEGE/OH	127	10.3	14.3	17.1		9.0	7.4	7.7
DAVIDSON COLLEGE/NC	88	10.1	8.3	13.0	12.5	10.6	9.5	7.5
WILLIAMS COLLEGE/MA	129	10.1	9.9	10.2	8.9	11.5	11.1	9.3
KALAMAZOO COLLEGE/MI	98	9.8	7.1	8.3	10.3	14.6	8.6	9.7
VASSAR COLLEGE/NY	133	9.1	13.5	8.6	12.5	3.7	7.5	9.5
BUCKNELL UNIV/PA	200	8.?	7.1	9.5	8.6	8.4	8.2	8.1
MT HOLYOKE COLL/MA	125	8.1	10.2	7.9	11.9	9.0	5.3	5.2
HAMILTON COLLEGE/NY	79	7.9	12.0	8.7	7.7	7.0	8.3	5.0

NOTE: TOTAL NUMBERS OF S/E PHDS ARE BASED ON DATA FROM 1969-70, 1970-71, 1971-72, 1972-73, 1973-74 AND 1974-75.

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TABLE 3

S/E BACCALAUREATE TO S/E PHD PRODUCTIVITY RATIOS FOR SELECTED LIBERAL ARTS COLLEGES, 1969-1974.

INSTITUTION	TOTAL # S/E PHDS	AVERAGE PRODUCTIVITY RATIO	S/E PRODUCTIVITY RATIOS 1969 %	1970 %	1971 %	1972 %	1973 %	1974 %
WOOSTER, COLL OF/OH	104	7.8	12.4	7.7	4.6	7.9	8.1	6.3
OCCIDENTAL COLL/CA	121	7.7	9.3	10.5	6.4	7.8	8.2	4.6
SMITH COLLEGE/MA	144	7.7	5.3	9.1	10.0	7.1	8.2	7.0
BELOIT COLLEGE/WI	88	7.5	6.5	10.5	6.2	10.5	7.2	5.0
MACALESTER COLL/MN	103	7.3	12.8	8.1	7.4	4.3	7.5	5.6
EARLHAM COLLEGE/IN	68	7.3		12.7	6.8	4.2	7.6	6.4
FRNKLN&MARSHAL C/PA	119	7.2	9.6	7.3	6.6	6.8	7.1	6.4
MIDDLEBURY COLL/VT	89	6.9	5.9	5.3	6.7	9.3	7.4	6.6
BOWDOIN COLLEGE/ME	74	6.9	9.7	8.1	9.4	7.7	2.6	4.7
WABASH COLLEGE/IN	51	6.8	6.9	7.1	4.5	9.8	6.1	5.8
BATES COLLEGE/ME	74	6.6	7.3	7.3	6.5	5.2	6.0	7.8
COLORADO COLLEGE	85	6.6	8.1	5.6	5.7	6.2	5.6	8.7
DENISON UNIV/OH	115	6.6	6.1	5.0	7.1	7.8	8.4	4.7
WHITMAN COLLEGE/WA	56	6.5	5.0	10.8	6.6	7.2	6.0	4.1
TRINITY COLLEGE/CT	80	6.1	7.2	6.3	6.8	4.6	6.6	5.1
HOPE COLLEGE/MI	70	5.9	4.1	6.9	5.9	7.6	6.0	4.6
COLGATE U/NY	123	5.8	8.8	6.1	5.0	7.4	2.9	5.9
KENYON COLLEGE/OH	47	5.8	6.7	5.6	5.5	3.0	8.7	5.2
WHEATON COLLEGE/IL	71	5.8	7.3	6.3	4.3	5.8	4.5	7.0
UNION UNIVERSITY/NY	137	5.7	5.1	5.4	6.4	5.6	4.8	6.7

NOTE: TOTAL NUMBERS OF S/E PHDS ARE BASED ON DATA FROM 1969-70, 1970-71, 1971-72, 1972-73, 1973-74 AND 1974-75.

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TABLE 3

S/E BACCALAUREATE TO S/E PHD PRODUCTIVITY RATIOS FOR SELECTED LIBERAL ARTS COLLEGES, 1969-1974.

INSTITUTION	TOTAL # S/E PHDS	AVERAGE PRODUCTIVITY RATIO	S/E PRODUCTIVITY RATIOS 1969 %	1970 %	1971 %	1972 %	1973 %	1974 %
ST OLAF COLLEGE/MN	117	5.7	6.3	5.4	5.4	5.6	7.3	4.0
DEPAUW UNIVERSITY/IN	85	5.4	5.8	6.2	5.5	5.9	5.6	2.9
MANHATTAN COLLEGE/NY	145	5.2	7.8	5.8	3.3	6.5	2.5	4.3
ALBION COLLEGE/MI	63	5.0	5.9	4.7	6.5	6.0	2.9	4.1
LAFAYETTE COLLEGE/PA	105	4.5	4.4	7.0	5.3	4.5	1.8	4.0
ALMA COLLEGE/MI	28	4.4	4.3	3.8	3.9	5.2	6.6	2.6
OHIO WESLEYAN UNIV	74	4.2	4.7	4.9	3.8	3.9	4.1	3.3
HOLY CROSS, C OF/MA	90	3.5	3.4	7.6	2.7	3.4	1.9	2.2
HAMPTON UNIV/VA	22	1.7	3 9	1.7	1.3	1.5	1.0	.0

NOTE: TOTAL NUMBERS OF S/E PHDS ARE BASED ON DATA FROM 1969-70, 1970-71, 1971-72, 1972-73, 1973-74 AND 1974-75.

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Predominately Women's Colleges

As noted in the previous report, the institutional productivity ratios for predominately women's colleges was generally low (the majority of the ratios falling between 1% to 3%). However, when the ratios were computed using S/E baccalaureate as the denominator, the ratios increased for most of the women's colleges (Table 4). This is obviously related to an earlier finding that large numbers of BA graduates from women's colleges are not focused in the sciences/engineering at the undergraduate level.

The reader should note that no ratios are presented for Radcliffe because the college merged with Harvard University prior to 1969. Furthermore, Sarah Lawrence College (NY) did not report S/E baccalaureate counts to the NCES, thus, making it impossible to calculate S/E productivity ratios for this institution.

During the 1969-1974 time period, Bryn Mawr College (PA), Wellesley College (MA) and Bennington College (VT) all showed an increase in their productivity over the institutional productivity ratios calculated for the 1950 to 1975 benchmark years.

In general, S/E productivity ratios for predominately women's colleges were higher during the 1969-70 and 1971-72 years.

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TABLE 4

S/E BACCALAUREATE TO S/E PHD PRODUCTIVITY RATIOS FOR PREDOMINATELY WOMEN'S COLLEGES, 1969-1974.

INSTITUTION	TOTAL # S/E PHDS	AVERAGE PRODUCTIVITY RATIO	S/E PRODUCTIVITY RATIOS 1969 %	1970 %	1971 %	1972 %	1973 %	1974 %
BRYN MAWR COLL/PA	90	13.9	17.3	21.4	11.0	14.0	13.6	8.3
WELLESLEY COLLEGE/MA	149	10.8	11.0	10.2	14.4	10.0	7.6	12.2
BENNINGTON COLL/VT	17	10.1	6.7	3.8	6.5	12.5	16.1	11.5
MT HOLYOKE COLL/MA	125	8.1	10.2	7.9	11.9	9.0	5.3	5.2
GOUCHER COLLEGE/MD	54	7.8	8.3	9.5	10.0	8.2	4.6	6.6
SMITH COLLEGE/MA	144	7.7	5.3	9.1	10.0	7.1	8.2	7.0
CONNECTICUT COLLEGE	51	5.6	4.1	6.1	6.4	5.1	3.7	9.1
WELLS COLLEGE/NY	21	5.4	12.3	5.2	1.9	5.4	4.2	1.8
RANDOLPH-MACN WOM/VA	26	4.7	2.8	5.4	7.4	3.7	4.2	3.1
SIMMONS COLLEGE/MA	44	4.6	5.8	1.4	4.1	6.0	8.0	2.1
ST JOSEPHS COLL/NY	11	4.5	12.2	.0	2.4	2.5	4.8	2.9
MILLS COLLEGE/CA	28	4.4	7.7	6.4	4.4	4.4	2.5	2.7
NOTRE DAME COLL/OH	8	4.4	5.6	2.9	3.6	4.0	8.3	3.1
SKIDMORE COLLEGE/NY	40	4.3	7.2	2.4	4.4	3.4	5.7	2.6
CHATHAM COLLEGE/PA	16	3.7	7.7	3.1	5.3	2.4	2.7	.0
WILSON COLLEGE/PA	13	3.6	2.4	6.2	6.8	5.5	.0	.0
CHESTNUT HILL C/PA	18	3.4	4.8	2.5	4.3	3.8	1.4	3.2
MANHATTANVILLE C/NY	28	3.2	4.4	5.2	6.3	3.0	.0	1.2
WHEATON COLLEGE/MA	29	3.2	3.7	3.3	2.1	2.3	2.7	4.5
ELMIRA COLLEGE/NY	24	3.1	4.4	2.1	2.5	3.6	3.6	2.2

NOTE: TOTAL NUMBERS OF S/E PHDS ARE BASED ON DATA FROM 1969-70, 1970-71, 1971-72, 1972-73, 1973-74 AND 1974-75.

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TABLE 4

S/E BACCALAUREATE TO S/E PHD PRODUCTIVITY RATIOS FOR PREDOMINATELY WOMEN'S COLLEGES, 1969-1974.

INSTITUTION	TOTAL # S/E PHDS	AVERAGE PRODUCTIVITY RATIO	S/E PRODUCTIVITY RATIOS 1969 %	1970 %	1971 %	1972 %	1973 %	1974 %
HOOD COLLEGE/MD	9	3.1	4.9	3.1	7.3	3.1	.0	.0
ALBERTUS MAGNUS C/CT	13	3.0	2.0	2.1	6.7	2.9	1.6	4.4
EMMANUEL COLLEGE/MA	26	2.8	6.4	2.6	2.6	1.4	2.7	1.0
TRINITY COLLEGE/DC	15	2.5	2.2	6.0	1.2	.0	2.6	.0
MT ST VINCENT,COL/NY	18	2.5	2.0	1.4	1.8	.9	4.4	4.4
AGNES SCOTT COLL/GA	11	2.4	2.4	1.2	8.5	1.3	.0	1.5
MARY WASHINGTON C/VA	34	2.3	2.6	2.4	1.4	3.9	1.3	2.0
ROSEMONT COLLEGE/PA	8	2.1	2.9	2.7	1.7	3.6	.0	1.4
REGIS COLLEGE/MA	16	2.1	2.5	2.7	2.1	2.7	1.9	.0
SETON HILL COLL/PA	9	1.8	2.4	.8	3.5	.0	.0	4.8
OUR LADY LAKE UN/TX	10	1.6	1.1	1.9	2.3	.9	.0	3.6
INCARNATE WORD C/TX	11	1.6	2.1	.8	3.1	1.4	1.4	1.0
SARAH LAWRENCE C/NY	38		NO DATA ON S/E BAs AVAILABLE					
RADCLIFFE C/MA			MERGED WITH HARVARD UNIVERSITY					

NOTE: TOTAL NUMBERS OF S/E PHDS ARE BASED ON DATA FROM 1969-70, 1970-71, 1971-72, 1972-73, 1973-74 AND 1974-75.

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Traditionally Black Colleges

With the exception of Clark College (GA) and Central State University (OH), the highest S/E productivity ratios for the 1969 to 1974 baccalaureates graduates of predominately black institutions occurred during the 1969-70 and 1970-71 time periods. The institutions with the highest BA to S/E PhD productivity ratios by year were Morehouse College and Clark College (GA). For Morehouse College as many as 6.3% of its 1970-71 graduates and 5.8% of its 1971-72 graduates earned PhDs in science/engineering. For Clark College, 6.2% of the 1973-74 graduates earned S/E PhDs. Overall, however, Howard University (DC) had the highest average S/E productivity ratio for 1969-1974 with 3.2% of its BA graduates earning PhDs in science/engineering.

The average S/E productivity ratios for black colleges during the 1969 to 1974 period varied only slightly from those institutional productivity ratios that were calculated in the previously referenced report on institutional productivity for 1950 to 1975.

00v239

TABLE 5

S/E BACCALAUREATE TO S/E PHD PRODUCTIVITY RATIOS FOR TRADITIONALLY BLACK COLLEGES, 1969-1974.

INSTITUTION	TOTAL # S/E PHDS	AVERAGE PRODUCTIVITY RATIO	S/E PRODUCTIVITY RATIOS 1969 %	1970 %	1971 %	1972 %	1973 %	1974 %
HOWARD UNIVERSITY/DC	128	3.2	3.3	4.3	2.9	3.4	3.0	2.2
MOREHOUSE COLL/GA	19	3.0	1.9	6.3	5.8	1.3	1.7	1.6
FISK UNIVERSITY/TN	24	2.9	2.9	3.8	3.6	1.6	1.3	4.1
CLARK COLLEGE/GA	12	2.9	.0	3.6	4.3	2.8	6.2	.0
TUSKEGEE UNIV/AL	35	2.3	4.0	2.0	1.5	2.5	.8	3.2
LINCOLN UNIV/PA	17	2.1	3.3	1.7	2.0	1.2	1.8	2.7
NC AG & TECH ST U	28	1.7	1.8	2.6	1.3	1.9	1.4	1.5
HAMPTON UNIV/VA	22	1.7	3.9	1.7	1.3	1.5	1.0	.0
CENTRAL STATE U/OH	11	1.7	.9	.9	2.3	.0	4.6	1.0
DILLARD UNIV/LA	8	1.6	4.5	.0	.0	2.0	2.8	.0
TOUGALOO COLLEGE/MS	10	1.5	2.1	3.1	2.5	.9	.9	.0
SPELMAN COLLEGE/GA	11	1.5	3.0	.0	1.1	2.1	1.4	.8
VIRGINIA STATE UNIV	13	1.5	1.7	4.1	1.5	.0	.0	1.7
JACKSON STATE U/MS	16	1.5	1.9	1.3	3.3	.8	.4	2.3
FT VALLEY ST COLL/GA	11	1.5	3.4	.0	1.3	1.7	1.0	1.5
MORGAN STATE UNIV/MD	23	1.3	2.1	.6	1.1	1.9	.8	1.6
NC CENTRAL UNIV	19	1.2	2.4	.8	.0	.7	1.2	2.3
TALLADEGA COLLEGE/AL	4	1.1	.0	3.2	1.4	1.8	.0	.0
SOUTHERN UNIV/LA	25	1.1		1.9	1.3	.8	1.2	.5
XAVIER UNIV/LA	7	1.1	1.1	1.0	1.7	.9	2.0	.0

NOTE: TOTAL NUMBERS OF S/E PHDS ARE BASED ON DATA FROM 1969-70, 1970-71, 1971-72, 1972-73, 1973-74 AND 1974-75.

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IV. S/E PRODUCTIVITY RATIO FOR SEVEN SELECTED BACCALAUREATE INSTITUTIONS FROM 1965-66 TO 1974-75

Seven institutions of varying sizes and characteristics were selected for a 10-year analysis of the BA to S/E PhD pipeline. In general, these institutions, shown in table 6, had their highest level of BA to PhD productivity during the mid-to-late sixties. However, the reader is cautioned regarding interpretation of the BA to PhD pipeline data from about 1971-72 to 1974-75 because, as shown below, the number of baccalaureate obtaining their PhD showed a decline during these years.

Year of BA	# of BA who have Earned S/E PhDs
1965-66	19,889
1966-67	18,605
1967-68	18,397
1968-69	19,350
1969-70	18,263
1970-71	17,185
1971-72	16,714
1972-73	16,142
1973-74	15,875
1974-75	14,546

Since PhD production in the U.S. increased steadily during the early to mid - seventies, one may hypothesize that the BA to PhD counts are declining because many of the baccalaureates are still in the PhD pipeline and have not yet received their formal degrees.

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TABLE 6

S/E BACCALAUREATE TO S/E PHD PRODUCTIVITY RATIOS FOR 7 SELECTED COLLEGES/UNIVERSITIES, 1965 TO 1974.

	S/E PRODUCTIVITY RATIOS										
	AVERAGE	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974
EMORY UNIV/GA	5.8	7.0	7.5	7.4	8.4	6.5		4.8	5.1	3.7	3.8
ILL, U, URBANA-CHAMP	8.8	11.1	11.0	11.0	10.3	9.6	8.6	7.9	6.6	7.1	6.5
MASS INST TECHNOLOGY	27.1	35.1	33.3	30.8	30.4	24.4	24.8	26.5	26.7	22.3	19.5
CORNELL UNIV/NY	13.6	18.6	14.4	14.7	12.4	11.4	11.1	10.9	11.3	17.5	17.6
REED COLLEGE/OR	26.8	30.7	25.5	21.2	33.7	26.7	24.6	24.3	30.9	26.6	21.6
BRYN MAWR COLL/PA	17.3	19.4	27.5	19.2	21.0	17.3	21.4	18.0	14.0	13.6	8.3
TEXAS A&M UNIVERSITY	5.0	9.3	7.8	7.6	7.3	6.6	4.4	2.9	4.3	2.8	3.6

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V. CONCLUSION

There did not appear to be a clear-cut trend in the BA to PhD productivity by year of baccalaureate for the undergraduate institutions analyzed in this report. However, many of the institutions analyzed did appear to have higher rates of productivity in the early seventies as opposed to the mid-seventies.

For those institutions where a large percentage of their baccalaureate graduates were in the science/engineering fields, little change was noted in their S/E productivity ratios from the institutional productivity ratios reported in the earlier report.

As one would have anticipated, most institution's productivity ratios increased when S/E baccalaureate totals were used for analysis. The largest increases were noted for those institutions that had a large percent of its baccalaureate graduates in nonscience/nonengineering fields.

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